



## A Study on the Biological Effectiveness of the Effect, Occurring by Copper Nanoparticles when Using the Yerba Mate Extract

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**Abstract:** The commercial demand increased for the nanoparticles because they are eligible for application on a large scale in various fields like electronics, Chemical catalytic, energy and medicine.

The mineral nanoparticles may be manufactured traditionally by humid chemical techniques, whereas the used chemical substances may be poisonous and flammable in many cases.

At this work, we described a technique effective in cost and co-friendly, for the green synthesis of Nanoparticles, by the extract of yerba mate plant as a reducing factor.

The nanoparticles had been described by using the Atomic force Microscopy (AFM).

AFM analysis shows that the average size of yerba mate particles amounts 70 nanometers. The current study points out that the nanoparticles have a good effect as a bacteriostatic agent for the tested E.coli and S. aureus.

**Key words:** Copper.

### 1- Introduction

Yerba mate is a plant growing in South America, Uruguay Mountains, Brazil, Argentina and most places in South America. It has various names like American holly, Paraguay tea and in Levant (Bilad Al-Sham) called mate. The scientific name of yerba mate is *ilex-paraguariensis*. Yerba mate is always green tree, growing in Argentina, Peru, Brazil, Uruguay and Chile, but it grows abundantly in Uruguay. This plant has characteristics like distinctive odor, bitter taste, stimulant to different senses, able to make the stomach empty, uretic, causing excessive sweating, and fever reducer.

Yerba mate contains water, cellulose, dextrin, resins, Glucose, Pentose, colloids, some fats, Folic acid, Caffeic acid, Chlorophyll, cholesterol, Some volatile oils, and great amounts of Vitamins as mentioned previously. The dust coming from burning the yerba mate contains Potassium, Lithium, Sulphur, Carbon, Chloric and Nitric acids, in addition to Magnesium, Manganese, iron and aluminum. This plant contains xanthines like Theophylline, Theobromine, Xanthine, Xanthine and all of them are strong alkaloids. It also contains the Mateine compound of high value and efficiency, in addition to

hundreds of components and chemical compounds, important for man health like Flavonoids, Important anti-oxidant and other important and useful components.

Yerba mate contain lots of Vitamins like A, B, B-2, B-1 and E, Riboflavin, Beta-carotene, Nicotine Acid, Biotin and minerals like magnesium and calcium, silicon, Phosphate, Phosphor, Hydrochloric Acid, Chlorophyll and Choline.

In addition it contains some fibers, resins, volatile oils and tans. The yerba mate contains a distinctive type of important organic compounds, called Xanthines, the most important of them is the Mateine compound, which has a great favor in the effectiveness of yerba mate as a general strengthening and stimulus for the body.

Currently, there is a trend to use natural green alternatives for preparing the nanoparticles because the researchers found that the plants contain compounds gathering the mineral Nano chips after reducing them, because they work as reducing factors for the minerals, by turning them to the Nano measurement. There are many researches for preparing the Nano minerals through the green chemistry, like preparing the golden Nano chips by using soya beans, green tea and other green preparations and the researches are still continuous because they are important in many industrial applications, because they have great effect against Bacteria. .

## 2- Procedure and used substances

### 2.1. The chemical substances

CuO Nanopowder of high purity (99.55 +/- 25-55 Nanometer). The products with high purity are prepared by using pure analytical chemical indicator like the raw materials and to be washed by the distilled water.

### 2.2. Preparation of the copper nanoparticles with the yerba mate extract.

10 grams of yerba mate to be put in 500 mm distilled water and heated till boiling, with moving it by magnetic drive, and then to be left until being cooled. Then, to filter the extracted solution and taking 40 mm and to add 10.0 g from CuO Nanopowder, and it is noted that the color of the solution has changed from yellow to black as seen in the figure (1)



**Figure (1):** The first jug represents the extract of yerba mate alone and the second jug represents the extract of yerba mate with CuO Nanopowder.

### 2.3. The procedure for studying the susceptibility of bacteria

The digging method was used for studying the effect of Eriobotrya Japonica in deactivating the growth of E coli and S.aurous Bacteria.

Two pits are done and the dishes were put in the incubator for 24 hours at 37 °C.

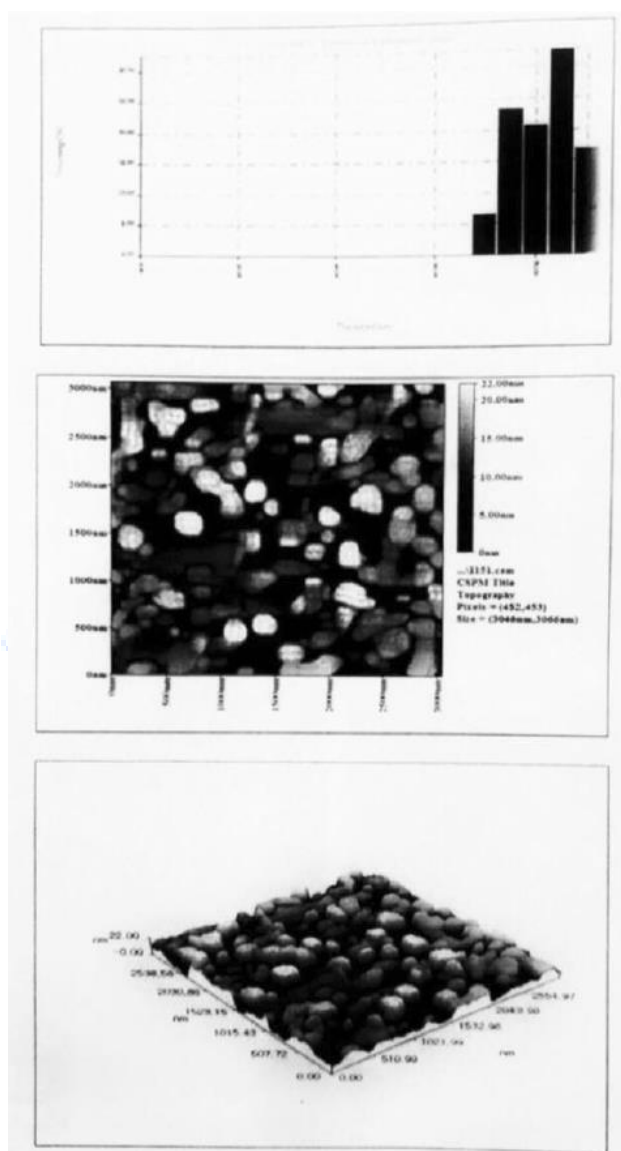
The pit to be dug by suberic drilling at equal dimensions for each species from bacteria, and the bacterial suspension to be diffused by cotton swab homogenous on Mueller Hinyton Ager medium, after being compared with McFarland standard tube.

The effectiveness of the extract was discovered by measuring the diameter of deactivation, using a ruler around each pit, for three repetitions to each isolation.

### 3. Results and Discussion

#### 3.1. Atomic Force Microscopy

The Macroscopic analysis of the Atomic Force Microscopy was used to know and draw the features of the Nano and micro dimensions. The surface topology of the copper nanoparticles surfaces for the extract of yerba mate was studied as seen in figure (2).



**Figure (2):** Atomic Force Microscopy for the copper nanoparticles of the two and three dimensions of the extract of yerba mate.

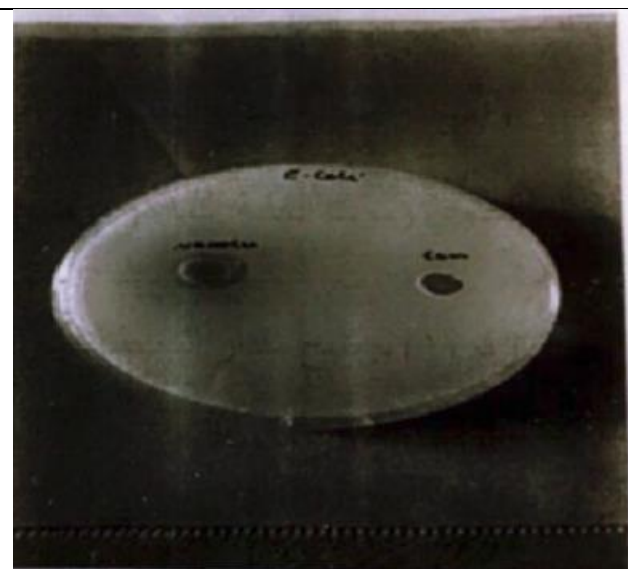
### 3.2. Studying the biological effectiveness:

The results showed that the copper nanoparticles, prepared by the yerba mate extract has effective antimicrobial activity, as appeared in the deactivation diameter amounting (10) mm, for *Escherichia coli* (E.Coli) and (15) mm for *Staphylococcus aureus* (S.aureus). This was a result of an experiment conducted under circumstances like 37 degree Celsius, development of two types of pathogenic bacteria to  $10^6 = OD600$  and testing various chemical compounds against pathogenic bacteria. These results are corresponding to the previous studies in this field.

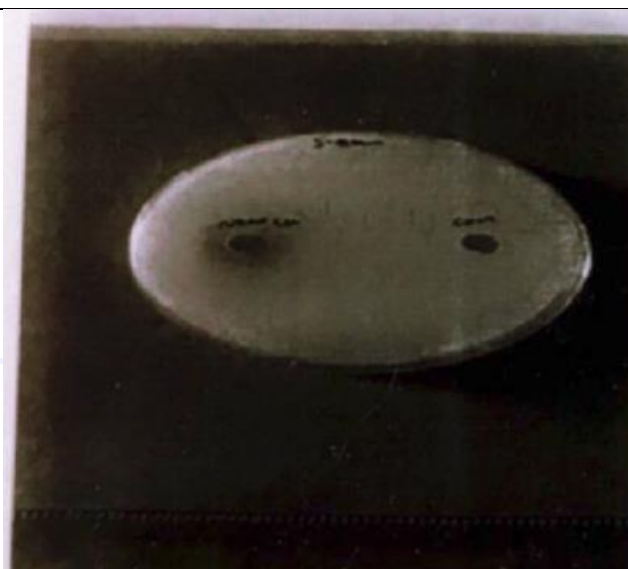
The effect of this deactivation shall be by the electrostatic attraction between the positive charge of copper ion and negative charge of cell wall or the microbes, producing free roots which cause deterioration to the cell wall and death of the cell, as shown in the figures (3) and (4) and in table No (1).

**Table (1):** Shows the amount of the copper nanoparticles against the tested bacteria

Deactivation diameter	Tested bacteria
10 mm	E.Coli
15 mm	S.aureus



**Figure (3):** The cross effect of copper particles, using the tested bacteria of *Escherichia coli* (E.Coli) species.



**Figure (4):** The cross effect of copper particles, using the tested bacteria of *Staphylococcus aureus* (S.aureus) species.

### 4. Conclusions

The study included the preparation of the copper nanoparticles by using the yerba mate in capacity as a reducing and stable factor. This method is co-friendly; it is green and depends on vegetable materials, non-costing and non-poisonous chemical substances, in addition to being prepared in one step at room temperature, giving results showing the homogenous Nano dimensions and during studying the biological activity for them they found that the copper nanoparticles work as a bacteriostatic agent. Therefore, they were used commercially for medical purposes.

### References:

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